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Cognitive mediation in people with dementia: Development, structural and construct validity of the first dementia specific measure

Running title: Measure of cognitive mediation in dementia

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Abstract

Objectives: Anxiety and depression are common and deleterious comorbidities in people living with dementia (PLWD). Cognitive behavioural therapy (CBT) is one of the few promising treatments, however it is unclear whether PLWD have the necessary pre-requisites to engage in this. Having an understanding of cognitive mediation; that a thought mediates the relationship between an antecedent event and its emotional consequence, is key for engaging with CBT and is also a critical component of emotion regulation. There are no measures of this construct validated for PLWD. This study aims to adapt and validate an existing measure for this population and other older adults (OA). Methods: A measure of cognitive mediation was adapted via expert and service user consultation for use in PLWD. 102 PLWD and 77 older adults without neurocognitive impairments (OA) completed the adapted measure along with two measures of emotion recognition and reasoning. Factor structure was examined and the measure reduced, with convergent validity assessed. Results: A final measure of 10 items (named the CM-Dem) was subject to factor analysis yielding a single factor solution. The measure showed good psychometric properties in PLWD, including good model fit, high internal consistency and inter-rater reliability, and moderate convergent validity with related constructs. In contrast, poor validity was found in the OA sample, especially a lack of convergent validity. Conclusions: The CM-Dem has clinical and research utility as a measure of cognitive mediation in PLWD, but less so in OA.

Keywords:

“cognitive mediation”, “measure development”, “emotion regulation”, “cognitive behavioural therapy”, “dementia”, “anxiety”, “depression”

Key points:

- This study aimed to develop and validate a dementia specific measure of cognitive mediation, which is key for engaging with cognitive behavioural therapy and for understanding emotional regulation more generally.
- A 10-item measure (named CM-Dem) was developed via expert and service user consultation. The measure showed good psychometric properties in people living with dementia, but less so in other older adults.
- The CM-Dem has clinical and research utility as a measure of cognitive mediation in people living with dementia.

Introduction

Anxiety and depression are common in people living with dementia (PLWD) ^{1,2} and associated with numerous adverse outcomes ^{1,2}. Side effects of antidepressants outweigh benefits for PLWD ³ and cognitive behavioural therapy (CBT) is one of the few promising interventions for reducing anxiety and depression in this group ⁴.

Cognitive mediation describes the process by which a thought mediates the relationship between an antecedent event and its emotional consequence ⁵. The ability to understand cognitive mediation is a core pre-therapy skill required to be ready for CBT. Measuring such pre-therapy skills in PLWD can aid understanding of who is ready to engage with CBT and which aspects they might be able to engage with ⁵.

Cognitive mediation is also a critical component of cognitive reappraisal ‘the ability to change an appraisal of a situation to upregulate positive, or downregulate negative, emotions’ ⁶. Poor cognitive reappraisal is associated with multiple psychological health problems ⁷ and decreased social functioning ⁶ in adults without dementia. Measuring cognitive mediation in PLWD could thus help with better characterising regulation of emotions and associated self-management of psychological problems in this group.

Despite the utility of measuring cognitive mediation, there is no measure validated for PLWD. It has been measured in people with intellectual disabilities and we focus here on adapting a measure initially developed for that population. The clinical version of this measure, used as a basis for adaptation, was initially introduced by Dagnan, Chadwick ⁸, with its theoretical conceptual background and application elaborated on by Dagnan, Mellor and

Jefferson ⁹. The original measure contains six items that describe a hypothetical event and an associated feeling of happiness or sadness. For each item, the participant needs to identify a thought congruent with the presented emotion. An example item is ‘You see a group of your friends but they do not say hello. You feel sad. What would you be thinking or saying to yourself?’ An example of an accurate response would be ‘They don’t like me’ ⁹. Responses are coded on a 1-7 scale and thoughts deemed congruent with the valence of the presented emotion scored as correct with the other six coding options detailing different types of ‘error’ (e.g. restating the emotion or the prompt event). Each event is presented twice, once associated with happy and once associated with sad emotions ¹⁰. This enables the rater to assess whether the individual is responding to the emotion presented and not the prompt event itself ^{9,10}.

A key issue in validation is the lack of clarity in the literature as to the dimensional structure of cognitive mediation. Some argue that it is best conceptualised as two dimensions ⁵: the ability to perform the task when the emotion presented is *congruent* with the ‘emotional valence’ of the prompt event (e.g. ‘you are sitting in the sunshine and feel happy’), and the ability to do so when the emotion presented is *incongruent* with the emotional valence of the prompt event (e.g. ‘you are sitting in the sunshine and feel sad’). Others argue that cognitive mediation is best conceptualised as one single dimension ¹¹. We sought to address this by establishing the factor structure of the measure – the first study in any population to do this – and validating the measure against related constructs.

Finally, possibly due to cohort effects ¹², even older adults without a recognised neurocognitive impairment may have poorer cognitive mediation skills. Thus, a secondary aim is to examine the psychometric properties of the measure in this group.

To summarise, our aims are (i) to adapt an existing measure of cognitive mediation for PLWD, (ii) to establish its factor structure, and (iii) to establish the psychometric properties of the measure in PLWD and older adults without dementia.

Methods

Sample

The sample for validation analyses is from the same cohort as that in a previously published paper, where eligibility criteria are outlined in detail ¹³. In brief, the sample consisted of two groups: (i) 102 people with mild dementia (PLWD group) and (ii) 77 people aged over 65 without dementia (OA group). The PLWD group were consecutive referrals from a memory clinic. Dementia was diagnosed according to consensus criteria ¹⁴⁻¹⁷ by a psychiatrist-led, multi-disciplinary team. All clients had cognitive assessment the extent of which was driven by client need as per best practice guidelines ¹⁸.

The OA group was a convenience sample of 77 healthy volunteers over the age of 65 without a diagnosis of dementia (determined through self-report) and not reporting subjective memory problems. They were recruited by advertisement in community groups and from the Join Dementia Research database ¹⁹.

All participants were fluent in English, had no self-reported literacy issues and had capacity to consent. Exclusion criteria included a DSM-IV Axis 1 diagnosis, diagnosed intellectual

disability, and significant uncorrected sensory deficits. As past CBT experience may influence performance on the measure, participants reporting current or previous experience of CBT were excluded. All participants from both PLWD and OA groups gave written informed consent to participate in the study. Ethical approval was given by NRES Committee London – City Road & Hampstead (REC Reference 14/LO/0554). Participant demographics and clinical characteristics are shown in table 1 below:

Insert table 1 about here

Adaptation of cognitive mediation measure

Prior to validity analyses, the original version of the cognitive mediation measure was assessed as to whether adaptation was needed and subsequently modified as described below. Procedures followed recommendations of Stewart and colleagues ²⁰.

Expert consultation. Following initial review by the lead author and two co-authors (GC, KS), the original measure was circulated to experts in CBT/emotional disorders and dementia for comment in relation to its suitability for measuring cognitive mediation ability in PLWD. Three recommendations followed from this process. First, to generate more prompt events suitable for older people (including PLWD) rather than intellectual disabilities. Second, to test the perceived emotional valence of prompt events, to confirm the categorisation of emotions as ‘congruent’ or ‘incongruent’ with the event (to date this was assumed by the measure’s authors rather than tested). Finally, to only include prompts of moderate emotional intensity because an intensely emotionally evocative prompt event might lack acceptability when paired with an opposing emotion.

Item generation. To generate new prompt events, a focus group was conducted with five people with dementia not included in the study sample. This was structured using modified nominal groups methodology, a procedure to reduce the impact of group processes on decision making²¹. Twenty new prompt events were generated, in addition to the original six prompts.

Validity check 1: prompt event valence and intensity. A survey methodology was used to test emotional intensity and which prompt events were associated with positive and negative emotional valences. The 26 prompt events were administered to an opportunity sample of 55 older people not included in the main study via an online survey. Order of presentation of events was randomised across participants. For each prompt, participants were presented with a list of emotions adapted from Izard's²² emotional taxonomy and asked which two emotions were most associated with the prompt. Responses were coded into three categories as either 'positive emotional valence', 'negative emotional valence' or 'neutral'. Emotional intensity was measured on a six-point verbal rating scale with anchors ranging from 'slightly (I would hardly feel this at all)' – 'as strongly as I have ever felt this'. Prompts were selected from this pool on the basis of two criteria: (i) at least 60% of participants indicated a positive or a negative emotional valence to the event, and (ii) prompts with moderate intensity scores (i.e. scoring in the bottom 60% of intensity for the sample). Ten prompts met these criteria, all of which were new prompts not included in the original measure.

*Validity check 2: expert validity testing*²³. The ten prompts were presented twice, once with the emotion 'happy' and once with the emotion 'sad' (20 items), to a group of 20 CBT professionals alongside the original measure instructions to determine which should be added to the final measure. Seven prompts with opposing emotions had 100% of responses coded as correct and were included in pre-testing.

Pre-testing of measure. The purpose of pre-testing was to assess item content, instructions, and presentation format. It also provided an opportunity to address additional queries raised by participants ²⁴. The final seven prompts were presented to five people with dementia (not involved in the main study), using a double interview technique as has been recommended for pre-test in PLWD ²⁴. This involved administering the measure using the original instructions as well as using follow-up questions to probe the reasons behind participants' responses, to ensure they understood the instructions in the way that they were intended. On the basis of feedback from pre-testing, one prompt ('your daughter calls you to tell you that a relationship has broken down') was changed to 'your friend calls you.....' since it was deemed not relevant if the respondent did not have a daughter. In addition, it was identified as essential (i) to supplement the verbal presentation of the measure with large written prompts to support memory and (ii) to develop standardised administration instructions about what to do if a participant did not respond or asked for clarification. Instructions were developed based on other standardised measure instructions used with a dementia population ²⁴. A final pool of seven prompts (14 items) were taken forward for factor analysis (see table 2 in results for details).

Data collection

Eligible participants were invited to take part in the study. Demographic information was gathered before administration of measures. Measures were presented in a randomised order.

Measures

There are no other measures of cognitive mediation for PLWD, so convergent validity was assessed by examining inter-correlations with measures of three other constructs that have been identified as CBT pre-therapy skills ^{5,9,25} and are empirically related with cognitive mediation ability in other populations.

Emotion recognition – ER40 ²⁶. The ER40 examines the ability to categorically identify facial expressions of emotion according to emotional valence, and has been validated in populations with mild Alzheimer’s disease ²⁷. It is a computer-based test consisting of 40 randomly presented colour photographs of felt or evoked, sad, happy, angry, fearful or neutral facial expressions. An overall recognition index is calculated (0-40).

Event emotion linkage - Reed and Clements’ assessment ²⁵. Six simple first person scenarios are described and also presented in written format. Participants are asked to identify whether they would feel happy or sad in that particular situation. A total score between 0-6 represents the number of scenarios answered correctly. This measure has been used previously in a dementia context with adequate acceptability and feasibility ²⁸.

Thought/feeling discrimination - BTFQ-D ²⁹. The BTFQ –D is a 14-item measure examining the ability to discriminate thoughts and feelings. For each item, a participant is asked to identify whether a prompt is a thought (e.g. ‘this is hard’) or a feeling (e.g. ‘frightened’). Correct responses are summed to give separate thought and feeling scores (range 0-7). Scores ≥ 6 on each subscale indicate above-chance responding. Validity for this measure has been established previously using a partially overlapping sample.

Data analysis

Data were analysed in the R environment (using Psych package ³⁰).

Cognitive mediation items derived from the adaptation process detailed above were initially examined for floor or ceiling effects. Any item having more than 90% or less than 10% correct responses in the dementia sample was removed prior to factor analysis ³¹. Item inter-rater reliability was assessed in a subsample of 54 participants (24 OA and 30 PLWD). Any unreliable items ($\kappa < 0.8$) were removed prior to factor analysis. To determine the factor structure and reduce items, factor analysis was conducted. Recommendations ³¹ indicated that a minimum sample of 120 was needed. Therefore, analysis was first performed in the entire sample before cross-checking the fit of factor structure in PLWD and OA samples. Data were categorical so factor analysis was based on the tetrachoric matrix using oblimin rotation. The number of factors to extract from the initial item set was based on parallel analysis ³². Once factors had been extracted from the initial item set, item reduction was conducted whereby items which loaded in ways not expected by theory, items with high cross loadings ³³ (identified by item complexity factor) ³⁴ and/or low loadings on the primary factor were considered for removal ³³. Following item removal, factor analysis was rerun on the final set of 10 items, with the parallel analysis used to determine the final number of factors to extract ³².

The internal consistency of the final measure was assessed with Cronbach's alpha. Interrater reliability of the overall measure score between two predetermined independent raters (EC and JS) was assessed for the same subsample of 54 participants (22% of the sample) as discussed above using a mixed model intra class correlation coefficient. Finally, convergent validity was assessed through correlations of cognitive mediation and the other measures detailed above.

The significance of correlations was adjusted for type 1 error using False Discovery Rate adjustment, a method that minimises type II error inflation ³⁵.

Results

Factor analysis

The sample for factor analysis is given in table 1.

Assumptions. All items met pre-specified criteria for reliability and floor and ceiling effects and were included in factor analysis (Table 2). The tetrachoric correlation matrix supported data factorability ³³ with nearly all correlations between items of at least moderate ³⁰ effect size (0.3 or above) in the expected direction.

Insert Table 2 about here

Factor extraction. Parallel analysis of the tetrachoric matrix in the full sample suggested a one factor structure. All items loaded significantly onto the single factor with large magnitude (range 0.5- 0.8). This was replicated in the PLWD and OA samples. In PLWD, all loadings were large and significant (Range 0.4-0.9). However, in OA items 3, 10 and 6 had very low loadings (0.17, 0.22 and 0.22 respectively) and were therefore removed. To maintain a consistent structure of presenting each event twice with the opposing emotion each time, item 13 (item 6 but with the opposing emotion) was also removed, leaving 10 items. Factor analysis was conducted again in all samples confirming the 1-factor solution in this reduced item set.

Model fit. The final model showed good statistical properties for the full (Table 3) and PLWD samples (accounting for 46% and 36% of the variance respectively). In these two groups loadings were above 0.45 with communalities 0.20 or above. The model fit was less good in the OA sample, with the model accounting for 30% of the variance with some communalities below 0.1. Internal consistency was high in all samples (0.70-0.82). The final version of the revised measure – named Cognitive mediation – Dementia Version (CM-Dem) – is included in Appendix A.

Insert table 3 about here

Validity analysis

Scoring. The CM-Dem total score (ranging from 0-10) was calculated by summing correct responses. A preliminary cut-off of 4 was chosen, as this score was obtained by fewer than 5% of the normative older-adult sample. Scores below this level are therefore likely to represent significantly greater difficulty than is generally found in older adults without cognitive impairment.

Descriptive Statistics. The number and percentage of participants correctly answering each item in the CM-Dem are given in table 2. The total scores were non-normally distributed therefore median scores and interquartile ranges are reported. The median score (interquartile range) of the measure was 6(5) in the full sample, 4(4) in the dementia sample and 8(2) in the older adult sample. Wilcoxon test showed that participants had significantly fewer correct responses on incongruent items compared to congruent (median congruent=4 vs median incongruent=3; $V=7990.5$; $p<0.001$).

Inter-rater reliability. Inter-rater reliability was high in all samples with ICCs ranging from 0.90 (OA) to 0.96 (full sample).

Convergent validity. Spearman's rank correlations between CM-Dem and the BTFQ-D (total score and subscales), emotion recognition and the Reed Clements task were all significant and mostly of moderate effect size (0.3 or above) when measured in the entire sample (Table 4). In the dementia sample, findings were similar save that correlations with the Reed Clements task were not significant. The older adult sample showed very little evidence of convergent validity, (no significant correlations between CM-Dem and other related measures).

Insert table 4 about here

Conclusions

The aim of this paper was to adapt and validate a measure of cognitive mediation ability for PLWD (named CM-Dem). This is the first measure of this construct validated for use in PLWD. It is of clinical relevance as it measures an important aspect of emotion understanding and regulation and is hypothesised to be important in CBT readiness ⁵.

Factor analysis indicated that the measure had a one-factor structure in PLWD and older adults, indicating that the differentiation of scores as congruent or incongruent cognitive mediation ⁵ is not warranted, at least for the CM-Dem. However, incongruent questions were answered incorrectly more frequently, which is consistent with the idea that cognitive mediation is a skill

that can be measured on a single dimension running from the easier congruent cognitive mediation to a more difficult incongruent cognitive mediation ⁵.

The measure showed good structural validity in the PLWD sample, including good model fit, high internal consistency and interrater reliability. The measure showed moderate convergent validity in this sample, indicated by correlations with measures of emotion recognition and thought-feeling discrimination. The lack of correlation with event-emotion linkage might be explained by a ceiling effect on the Reed Clements measure and consequent lack of variability leading to lack of power.

The psychometric properties in the OA sample were weaker. Model fit was not as good as in PLWD and, whilst inter-rater reliability was high, the measure showed no convergent validity with measures of related constructs. For the feelings subscale of the BTFQ-D and the Reed Clements scale this could be explained by a ceiling effect in older adults. However, the reasons for this are less clear for the thoughts subscale of the BTFQ-D and the ER-40.

Strengths and Limitations

The study had several strengths. In particular, the theoretical coherence of the measure was bolstered through consultation with experts and by basing the measure on work in other cognitively impaired populations and a model of CBT pre-therapy skills ³⁶. The content validity and relevance of the CM-Dem to PLWD was enhanced by our consultation and pre-testing using methods adapted and of known utility for this population ^{11,24,37}.

In terms of limitations, concurrent validity assessment was limited by the lack of measures of the same construct meaning that assessment relied on correlations with measures of related constructs. It is consequently unclear whether the CM-Dem measures cognitive mediation ability specifically or a more general construct of ‘understanding of emotions’. Finally, and critically, although there is some limited evidence that cognitive mediation understanding may change in people with intellectual disabilities over the course of CBT ³⁸, the relationship of this measure to CBT outcome remains unclear. The lack of such evidence means that the CM-Dem should not yet be used as a stand-alone measure to determine suitability for CBT.

Research and clinical implications

The present study suggests that the CM-DEM can be reasonably interpreted as measuring a single factor of ‘cognitive mediation’ for PLWD.

The promising psychometric properties of this measure indicate that it could be used in research for analysing between-group differences and within-group associations in PLWD to further understand (i) ability to regulate emotions and (ii) CBT readiness ¹¹ in PLWD.

This measure could also be used in a clinical setting to assess a PLWD’s ability to understand cognitive mediation, with implications for (i) characterising their emotion regulation abilities and (ii) tailoring a CBT intervention. The preliminary normative cut-off scores on the measure could be used in clinical practice to provide an indication of when a PLWD might need more support in terms of developing this skill. Such support might take the form of CBT pre-therapy skills training, which is effective in people with intellectual disabilities ³⁹. A limitation to this is that the preliminary cut-off score is based on performance of an OA sample that is, on

average, younger, more highly education and higher average premorbid IQ scores than many PLWD samples. However, with further validation, the CM-Dem could perhaps be used as part of a battery of tests to help inform clinical decisions for a given client regarding which intervention within the CBT umbrella might be most appropriate (e.g. less cognitively demanding pleasant event scheduling vs potentially more demanding cognitive restructuring).

Ethics approval and consent to participate

All participants from both dementia and control groups gave written informed consent to participate in the study. Work was conducted in compliance with ethical guidelines on human experimentation [24]. Ethical approval was given by NRES Committee London – City Road & Hampstead (REC Reference 14/LO/0554)

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Tables:

Table 1: Demographics of the sample

Variable	Older adults (n=77)		Dementia (n= 102)		Significant contrast [†]
	Median (min-max)	% (N)	Median (min-max)	% (N)	
Age	72 (65-92)		81 (58-97)		PLWD > OA
Sex (M)		36 (28)		43 (44)	No sig contrasts
Ethnicity (White)		100 (77)		90 (92)	No sig contrasts
Education (years)	16 (7-25)		12 (5-25)		OA > PLWD
Cognitive impairment (ACE-III score)	95 (67-100)		74 (43-98)		OA > PLWD

[†]Significant at $p < 0.05$, adjusted for false discovery rate

Medians and ranges reported due to non-normally distributed data.

Table 2: All items taken forward from pre-test with responses for all samples

Item	Prompt	Presented	% (n)	% (n)	% (n)	Interrater
		emotion	correct – full sample [†]	correct PLWD [*]	correct OA [§]	reliability*
1	You are sitting in the park and the sun is out	Happy~	71(124)	59(58)	86(66)	0.94
2	You are eating a meal at home on your own	Sad~	61(107)	48(47)	77(59)	0.96
3	A friend calls to cancel a trip you had planned	Happy	58(102)	38(37)	83(64)	0.92
4	You are shopping and you see a friend you have not seen for ages	Happy~	69(120)	59(58)	82(62)	0.89
5	Your GP who has treated you for years tells you she is retiring	Happy	56(98)	37(36)	81(62)	0.96
6	A very close friend calls to tell you their relationship has broken down	Sad~	54(95)	42(41)	70(54)	0.81
7	You are sitting in the park and the sun is out	Sad	47(82)	24(23)	77(59)	0.85
8	You are watching television when one of your favourite films comes on	Sad	50(88)	38(37)	66(51)	0.88

9	You are eating a meal at home on your own	Happy	63(110)	45(44)	87(67)	0.87
10	A friend calls to cancel a trip you had planned	Sad~	54(95)	39(38)	73(56)	0.96
11	You are shopping and you see a friend you have not seen for ages	Sad	49(86)	29(28)	75(58)	0.93
12	Your GP who has treated you for years tells you she is retiring	Sad~	56(98)	41(40)	75(58)	0.81
13	A very close friend calls to tell you their relationship has broken down	Happy	61(107)	44(43)	83(64)	0.88
14	You are watching television when one of your favourite films comes on	Happy~	70(123)	62(61)	79(61)	0.91

†n = 175; Dementia (PLWD) ‡n=98; Older adult (OA) §n=77 *n=54

~Indicates that the presented emotion is deemed congruent with the prompt (all others presented emotions are deemed incongruent with the prompt)

Items included in the final CM-D measure are shown in bold

Table 3: Factor structure of final 10 items in full sample

Item	Rotated factor loadings	Communalities
11	0.83	0.68
7	0.81	0.66
5	0.75	0.56
12	0.69	0.48
9	0.67	0.45
1	0.61	0.37
14	0.61	0.37
8	0.57	0.33
2	0.52	0.27
4	0.52	0.27
Eigenvalues	4.45	-
% of variance accounted for	46	-
Internal consistency (Cronbach's alpha)	0.82	-
ICC (SEM)	0.96 (0.86)	-

ICC=Intraclass correlation coefficient; SEM=Standard error of measurement; N=54 for ICC calculation

Table 4: Correlations between CM-Dem and other measures in the full and subsamples

	Full		
	sample [†]	Dementia [‡]	Older adults [§]
Feelings score BTFQ-D	0.38	0.32	0.06
Thoughts Score BTFQ -D	0.42	0.38	0.17
Total Score BTFQ -D	0.47	0.42	0.15
Reed Clements Score	0.21	0.17	0.12
ER40 –score	0.35	0.29	0.12

[†]n=160, [‡]n=84, [§]n=76, correlations in bold significant at p<0.001

All correlations were Spearman's rank due to assumptions of normality of distribution not being met. All P values were corrected for type 1 error using false discovery rate.

Appendix 1:

CM Dem measure

Say: *'I am going to give you a situation and a feeling. I am then going to ask you what you would be thinking in that situation if you felt that way.'*

If they indicate they don't understand, repeat instructions as necessary emphasising that they need to tell you what they would be thinking. Go on to the task regardless of clear understanding saying, *'That's okay. Let's try a few anyway'*, but make a note that weren't clear on instructions.

Researcher reads each scenario and gives a written version with a happy or sad face to aid memory.

Were they clear on instructions (circle as appropriate)

Yes

No

For each item say the prompt event and associated emotion followed by *'What would you be thinking or saying to yourself?'*

Prompt and emotion	Response	Coding*
You are sitting in the park and the sun is out and you feel HAPPY.		
You are eating a meal at home on your own and you feel SAD.		
You are shopping and you see a friend you have not seen for ages and you feel HAPPY.		
Your GP who has treated you for years tells you she is retiring and you feel HAPPY.		
You are watching television when one of your favourite films comes on and you feel SAD.		
You are sitting in the park and the sun is out and you feel SAD.		
You are eating a meal at home on your own and you feel HAPPY.		
You are shopping and you see a friend you have not seen for ages and you feel SAD.		
Your GP who has treated you for years tells you she is retiring and you feel SAD.		
You are watching television when one of your favourite films comes on and you feel HAPPY.		

*Codes are as follows: 1 = appropriate a-c link; 2 = Disagree emotion; 3 = Respond to activating event; 4 = Restate activating event; 5 = Restate emotion; 6 = Unclassified; 7 = No response